

Description of *Opisthoteuthis depressa* n. sp.

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With Plate XXXIII.

During May last, a small octopod, apparently belonging to the rare and very peculiarly shaped genus, *Opisthoteuthis*, was brought to us by our collector, a Misaki fisherman, who obtained it on the southern side of Okinose,¹⁾ about sixteen kilometres west of Cape Sunosaki. It had taken one of the hooks, baited with shark-flesh, of a long line for deep-sea fishing, at a depth of about 250 fathoms. This locality is one of those in or about Sagami Bay, that seem to be teeming with zoological novelties. It is a rich Hexactinellid ground, and of the numerous interesting objects which it has recently yielded to us, might here be mentioned a living *Pleurotomaria Beyrichi*, likewise hooked up by a snood of a long line.

The genus *Opisthoteuthis* was instituted in 1883 by Verrill²⁾ to receive a West Indian species, named *O. Agassizii* by the same author. So far as we can ascertain no second species has since been added to the genus. In proposing then, the name of *O. depressa* for our Okinose specimen, which differs in many important points from Verrill's species, we consider it unlikely that we are adding but an unnecessary synonym to the literature of Cephalopods.

1) A submarine bank situated about 18 kilometres south of Misaki.

2) "Supplementary Report on the 'Blake,' Cephalopods." *Bull. Mus. Comp. Zool.*, Vol. XI. Also, "Mollusca of the New England Coast." *Trans. Conn. Acad.*, Vol. VI.

Hoyle¹⁾ seems to have entertained some doubt as to whether *Opisthotentis*, together with *Staurotentis* Ver., is not identical with *Cirrotenentis* of Eschricht. In our judgment, so far as *Opisthotentis* is concerned, its generic distinction may well be considered as valid, preeminently on account of the unusually depressed head and body, which condition, conjointly with the thick and swollen brachial webs, gives to the animal a shape quite exceptional among Cephalopods. Except for the projecting tips of its arms, it may be compared to a plano-convex disc, of which the plane side is the inferior or the anterior and represents the inner surface of the umbrella. The arched superior or posterior surface includes not only the posterior aspect of an ordinary cephalopod body, but also the dorsal and ventral surfaces as well as the outer surface of the umbrella. The head and body are thus flattened antero-posteriorly. This is accompanied, as might naturally occur, by an outspread of these parts laterally and especially along the ventral web, whereby such parts are, so to say, pushed into the umbrella beneath its outer skin. Hence, the lateral portions of the broadened head and body lie directly over the bases of the lateral arms, while the median portion of the body directly overlies the two ventral arms to a considerable extent. At the same time the siphon and the branchial aperture are shifted over to a considerable distance on the outer surface of the median ventral web, and are directed in the ventral, not in anterior direction as is usually the case. The close and wide connection thus established between the head and body on the one hand and the umbrella on the other, accounts for the fact that the latter, with arms enclosed in it, is horizontally expanded, the former acting as a restraint against its closing.

1) Challenger Report. Vol. XVI. p. 230.

Apparently the same state of things in *O. Agassizii*, as put down above, is described by Verrill in a different way. According to him, the depressed body is together with the head "closely united" or "wholly adnate to the web connecting the arms, except at the posterior end behind the fins, where it is slightly free and overhangs a little." Again, it is said that the head and body are so closely adnate to the branchial membranes "as to entirely conceal the ventral portions." The position of the siphon and branchial aperture is pointed out by Verrill as being remarkably "posterior." The terms used by him are misleading in so far as they lead one to think that the body had laid itself down in such a way as to have come into union with the webs by its ventral surface, and that the siphon and the branchial aperture had shifted their positions along the ventral surface of the body towards its posterior end. Such is, in our opinion, decidedly not the case. The ventral portion of the body is nowhere to be considered as being concealed, except perhaps the mantle-rim, which is reflected inwards at the branchial aperture (*a*, fig. 9). On the contrary, it stands, at least for the greater part, exposed more than ever, only with this peculiarity, that it forms a part of the general superior surface, thereby losing all definable boundaries from the real dorsal region or from the outer surface of the umbrella. Nor is there any ground for supposing that the siphon and the branchial aperture have any way approached the original posterior end, which is, strictly speaking, to be sought somewhere near the middle of the upper surface of the flattened body, behind the position of the dorsal cartilage. While thus retaining their usual relative position to the posterior body-end, they have shifted themselves a remarkable distance away from the centre, and along the outer surface, of the umbrella.

To go on with the description of our specimen of *O. depressa* the entire superior surface (fig. 2) is covered with a wrinkled and flabby

skin, the wrinkles abounding most near its margins where they generally run, with interruptions, in circular curves. Many of these were probably to be seen even in the living state when the arms were at rest, certainly to disappear, however, under the tension caused by certain movements of the latter. Others may be the result of contraction brought about by immersion in alcohol. Underlying the skin there is a thick layer of very soft connective-tissue, that fills up the webs and also covers the outer aspect of the arms; so that, while it gives such a thickened or swollen appearance to the former, it conceals the latter beneath it, making their course untraceable on the outer side of the umbrella. The same condition should also obtain in *O. Agassizii*.

As already mentioned, the entire superior surface is gently convex, but its central portion, *i.e.*, the head and body proper, in our alcoholic specimen must be described as being rather flattened, except in the region of the eyes, where, it somewhat heaves up into rounded prominences presenting the most projecting points of the upper surface (fig. 1). Otherwise, the head is as low, and about as large and as broad, as the body. The latter does not overhang in any degree the branchial aperture, a condition suggesting that the depression of the body in the present species is carried somewhat to a greater extent than in *O. Agassizii*.

The eyes, which should be very large in *O. Agassizii*, are here of moderate size, and are separated from each other by a wide interorbital space. Their external openings are small semilunar slits, disposed longitudinally and with membranous upper and thick lower lids. The distance between the two openings exceeds twice the diameter of the eye-bulb, but is about equal to their distance from the free edge of the dorsal web.

The fins are very small compared with those of *O. Agassizii*. In

our specimen the left fin is shrunk and smaller than the other, evidently owing to careless handling when fresh. The right fin is well preserved, rather thick and triangular in shape, being about one and a half times as broad (transversely) as it is long. The free apex is rounded and of the two edges, the anterior is somewhat more arched than the posterior. The shape, however, is likely subject to changes, according to the different state of contraction of the internal tissues, as the fins are very soft structures containing no supporting elements whatever. Nevertheless, on raising them from their natural, laterally directed position and then releasing them, they return to the original position of their own accord. The place of their attachment is close behind the eye-bulbs, the distance between the middle of the fin-base and the eye-opening being about one fifth of the distance of the former from the branchial aperture. Moreover, the fin-base is situated more to the middle than the eye-opening, while the fin itself extends laterally but a short distance beyond the same.

The branchial aperture is a small crescent-shaped opening, situated at a distance from the free edge of the dorsal web about four times as great as that from the ventral web. It partially embraces the siphon, which, so far as it shows itself outside the branchial aperture, is of very insignificant size. No part of it can be said to be freely projecting beyond the surface of the ventral web and its presence is only revealed by a slight prominence and by the existence of a small, transversely slit-like siphonal opening close behind the branchial aperture.

As already mentioned, the inner or inferior surface of the umbrella (fig. 3) is plane. The arms do not project above it, except very near the tips, where the webs becoming thinner and fold-like, join them on their upper sides. The skin is tolerably firmly attached to the inner surface of the arms, as a result of the fact that there is interposed on

this side little or no soft connective-tissue, so richly developed within the webs as well as over the outer surface of the arms. The entire skin is on the whole smooth, at any rate by no means so flabby as on the outer side of the umbrella. This difference in the amount of skin on the two surfaces is assuredly a provision, by which the animal is readily enabled by special exertions of its muscles, to assume a shape concave on the lower side, as, for instance, when it would attach itself by means of suckers to a projecting substratum or when it would exercise swimming motion by alternate closure and expansion of its arms. We believe the kind of locomotion just mentioned is of much greater moment to *Opisthotentis* than to most other Cephalopods, since the ejection of water from the comparatively small branchial chamber and siphon can not but be of subordinate significance.

The mouth is situated somewhat eccentrically, *i.e.*, a short distance nearer to the free edge of the dorsal web than to that of the ventral. Its position about corresponds, on the superior aspect of the animal, to the middle of a line connecting the anterior ends of the fins. There is a finely verrucated buccal membrane present in the mouth. The jaws show no characteristic features that seem to be worth noticing (figs. 4 & 5). We have sought in vain for the radula, but will not positively assert its total absence.

The arms are subequal. The longest is the second lateral arm, after which the ventral, the first lateral and the dorsal arms are successively shorter in the order mentioned. As seen after denuding them of skin, they are rather stout and are thickest at the base, where they come in contact with one another and whence they gradually taper off towards the tips. According to Verrill, the arms of *O. Agassizii* are much narrowed towards the bases and these are said to be not in contact,—a description presumably based solely on their external appearance on the inferior side, where the suckers decrease in

size and the zone between the two rows of cirri lessen in breadth towards the base of the arms. The free ends are rather slender, are compressed, and more or less outwardly curled. By far the greater extent, say about nine tenths of the entire length of arms, is plainly webbed, and such portions show a remarkable curvature on the same plane, *viz.*, both right and left arms are all more or less curved dorsad, so that while the two dorsal arms face each other with their concavity, the two ventral arms do so with their convexity so that their ends are turned laterad away from each other (fig. 3). None of the arms shows any sign of hectocotylyzation.

Consequent upon the horizontal curvature of the arms, the edge-line of the dorsal web is the least extensive of all, since the two dorsal arms approach each other towards their ends. Moreover, it is deeply slackened in, giving rise to a median angular notch, the two sides of which are symmetrical. On the other hand, the ventral web has, as is easily comprehensible, the most extensive edge-line, which is almost straightly stretched. With respect to the lateral webs, their edge-lines are all of about the same extent, always with this peculiarity, that every one of them is obliquely indented, so as to form an open angle, the apex of which lies at least four times more distant from the tip of the next dorsal arm than from that of the next ventral. As the result of this fact, a lateral web can not be divided by any line into two symmetrical parts and each lateral arm, as also the ventral arm, has a greater stretch of narrowed web-continuation along the ventral than along the dorsal side near its end. There is then an appearance as if the two ends of the free edge of a lateral web terminated at unequal distances from the tips of the arms connected by it, as is known to be the case in some Cephalopod species. But such seems not to be the real state in *O. depressa*. We are rather inclined to consider that the above described condition of lateral webs is merely

dependent upon the peculiar horizontal curvature of the arms bearing them, and that their shape would be similar to that of the dorsal or of the ventral web, should the bounding arms dispose themselves respectively like the dorsal or the ventral arms, what is likely to happen not unfrequently during life.

The suckers and cirri show an arrangement as in *O. Agassizii*. The former, arranged in a single row to each arm, number 42-52 as far as can be counted, the greatest number being found on the ventral arms. They are on the whole very small. Along the greater part of the arms, they are of about the same size, but do gradually though slightly decrease in size both proximally and distally, becoming especially smaller towards the tips of the arms. Unlike *O. Agassizii*, those situated about halfway along the arms are not any smaller than those which precede or follow them. The suckers have simple hollows, their edges being generally but little prominent above the surface of the skin.

The cirri, present in two rows on each arm and alternating with its suckers are very inconspicuous structures, being small, slender and attenuated to a point. Those towards the tip and also those close to the base of the arms are especially insignificant, being reduced to mere minute prominences. They commence proximally between the first and the second suckers. The space enclosed between the two rows of cirri is broadest halfway along the arm and narrows towards either end of it.

The colour, as observed on the second day after the specimen had been put into weak alcohol, was predominantly madder-red. On the superior surface, the head and body were somewhat uniformly of that colour, but very dull in tone, except in the region just above the eyes and the under surface of the fins, where they were poor or altogether wanting in pigment. On the periphery of the superior surface the

chromatophores were arranged in streaks that generally ran with interruptions, in circular paths. On the inferior surface, the red was principally confined to the interbranchial spaces, the greater part of the arms themselves as well as the cirri and suckers being of light colour.

The measurements of our specimen are as follows :

Median diameter of the entire animal, 55 mm.

Transverse diameter across fins, 65 mm.

Thickness at the middle of head, about 8 mm.

Length of body and head, from the branchial aperture to the level of the anterior borders of eyes, 27 mm.

Breadth of body proper, about 23 mm.

Breadth of head across eyes, 26 mm.

Between eye-openings, 22 mm.

Diameter of eye-bulb, 9 mm.

Between fin-bases, 17 mm.

From base of fin to its tip, 5 mm.

Thickness of arm near base, $6\frac{1}{2}$ mm.

Length of dorsal arm, 38 mm.

Length of 1st lateral arm, 44 mm.

Length of 2nd lateral arm, 48 mm.

Length of ventral arm, 46 mm.

Length of dorsal web from mouth, 23 mm.

Length of ventral web from mouth, 27 mm.

Breadth of lateral web from mouth, 25-27 $\frac{1}{2}$ mm.

Diameter of largest sucker, 1 mm.

Length of longest cirrus, $1\frac{1}{4}$ mm.

Of the internal anatomy we can offer only such scanty notes as could be taken after a few incisions made so as to least impair our unique specimen.

The presence of a dorsal cartilage could only be ascertained after partially removing the dorsal skin. It is a single, transversely situated, cartilaginous bar (*c.*, fig. 6), no part of which is directly continued into the fins. Here is another important point of difference from *O. Agassizii*, in which it should occur in two separate pieces, each contained in the fin itself. The simple cartilaginous bar of the present species, is thin, 1 mm. broad (antero-posteriorly), 9 mm. and 11 mm. long respectively along the anterior and the posterior edge. It is situated about 4 mm. behind the level of fins, beneath the thick skin and closely over the visceral sac above the posterior part of the liver (*d.c.*, fig. 9). From its either end a muscle takes its origin (*m.*, fig. 6). The latter soon bends forwards and inserts itself at the fin-base of the respective side.

Cutting open the mantle-cavity, the siphon, of which but a small portion was visible from outside, is exposed in its entire length (fig. 7). It then measures 7 mm. in length and about as much in breadth at the base, representing a much flattened cone in its general shape. Its lower wall, which corresponds to the dorsal aspect of the siphon of normally shaped Cephalopods, is completely adnate with the connective tissue of the ventral web. Its muscular substance splits, just beneath the anus, into two bands, which after running antero-laterally beneath the branchial chambers, finally become lost in the connective tissues. The upper wall of the siphon is covered by the chromatophore-bearing skin directly continuous with that of the outer surface of the umbrella and is reflected outwards along its free edge at the siphon-basis, especially so at two lateral positions which evidently serve as the so-called button (*but.*, figs. 7-9).

The mantle-edge at the branchial aperture is reflected inwards (*a*). The reflected edge is laterally continued into a fold (*b*), which incompletely shuts off the branchial chambers on the median side and

whose edge is capable of being clasped by the above mentioned button of the corresponding side.

It is convenient for description's sake to speak of two branchial chambers, each containing a gill and which communicate with each other, provided the buttons are fixed, by only a narrow space at the inner end of the siphon. From this connecting space the two branchial chambers extend divergently forwards and laterally for a distance of about 11 mm. They overlie the connective tissue of the umbrella, clasp from behind the visceral mass and are superiorly covered by the mantle (*man.*, fig. 7) which strictly speaking represents their ventral wall. On the floor of the connecting space and right at the inner end of the siphon, there is a medianly situated, rounded elevation, bearing the anus, discernible as a blackish spot (*an.*, fig. 7). The said elevation is posteriorly closely embraced by a thin fold, likewise of the floor, and is superiorly directly continuous with the median septum (*sep.*) that divides the entrances into the two branchial chambers.

Each of the latter is widest near the siphon-base and narrows antero-laterally to a cleft-like terminal portion. The widest portion is occupied by an extremely shortened gill (*gi.*), which is attached to the membranous anterior wall enclosing the visceral mass (*v.w.*). Thus the gill is directed backwards or ventrad. Around its short rachis are grouped together the lobular lamellæ, so that the entire organ is reniform and presents an appearance not unlike that of half of a peeled orange. There are in all six lamellæ to each gill, but the one most medianly situated is very rudimentary and can not be observed when seen from above.

It was of course very desirable to determine the sex of our specimen. Although there was no sign of hectocotylization on any of the arms, we discovered immediately on opening the mantle-cavity,

an organ which could not but be taken for the penis. In fact, further dissection soon verified the view that we had before us a young male. It is to be assumed that the hectocotylization had not yet commenced in our specimen.

The penis (*p.e.*) is a tube-like body about 3 mm. long, arising from the anterior wall of the left branchial chamber, about midway between the anus and the gill. It is directed backwards towards the inner end of the siphon. Within the visceral sac, the penis-root is directly continuous with a swollen ovate body (*sp.s.*, figs. 8 & 9), which looked as if consisting of a coiled tube, apparently owing to the presence of spirally arranged folds within. We identify this body as the spermatophore-sac. This is joined at its anterior end by another ovate body (*pr.*) of about the same size, situated on the left of the cœcum. This is probably the prostata. It is a thin-walled sac that contained a whitish mass, which, on close examination, proved to consist of certain epithelial duplicatures. From the junction between the prostata and the spermatophore-sac, a rather thick and spindle-shaped duct (*s. r.*), which proceeds towards the right, eventually to continue itself into the thin vas deference. The swollen part of the spindle-shaped duct exactly corresponds in position to the seminal vesicle of other cephalopods. The vas deferens (*v. d.*) runs at first towards the left and then sharply turns on itself to pursue an opposite course, thus forming a loop that seems to be connected with the spermatophore-sac by a filamentous band. The organ, which is to be considered as the testis (*tes.*), consists of three elongated lobes or rami. The first and the longest runs obliquely forwards and towards the left, crossing over the seminal vesicle and the prostata; the second runs forwards over the cœcum and the third, which is the shortest, pursues a downward course behind the cœcum. The rami have a thin membranous envelope, the capsule, and contain a minutely verrugated

mass. The latter, on microscopic examination, was found to consist of a complicated system of epithelial duplicatures, the cells of which were cylindrical or spindle-shaped and regularly arranged. These are probably to be considered as spermatoblasts. Nowhere is the spermatozoon to be found, indicating that our specimen stands in a very young stage of sexual development.

Of other anatomical facts, incidentally observed during the dissection of the genital parts, we find no points of particular interest and therefore prefer to leave them here unnoticed, only referring the reader to what are embodied in our fig. 9, Pl. XXXIII.

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Explanation of Plate XXXIII.

Opisthotenthis depressa Ij. & Ik.

- FIG. 1. Side-view. Nat. size.
- FIG. 2. Superior view. Nat. size.
- FIG. 3. Inferior view. Nat. size.
- FIG. 4. Ventral jaw. $3\times$.
- FIG. 5. Dorsal jaw. $3\times$.
- FIG. 6. Dorsal cartilage and its muscles exposed. $2\times$.
c, Cartilage.
m, Muscles.
f, Fin.
- FIG. 7. Mantle-cavity exposed by incisions on either side of the branchial aperture and mantle thrown forwards so as to show its inner surface. About $2\times$.
a, Reflected rim of the branchial opening.
an., Anus.
b, Continuation of *a*, capable of being clasped by the button *but*.
br. h., Branchial heart peering through the visceral wall.
but., Button.
gi., Gill.
man., Inner surface of mantle.
pe., Penis.
sep., Septum of the mantle-cavity.
si., Siphon.
si. o., Opening of siphon.
- FIG. 8. Reproductive organs, diagrammatically represented.
an., Anus.
pe., Penis.
pr., Prostata.
sp. s., Spermatophore-sac.
s. v., Seminal vesicle.
tes., Testis.
- FIG. 9. Half-imaginary median section.

- a. b.*, Arm-base.
br. o., Branchial opening.
buc. b., Buccal body.
c. g., Cerebral ganglion.
ce., Cæcum.
d. c., Dorsal cartilage.
e. b., Eye-bulb, right.
in., Intestine.
l., Liver, right lobe.
op. g., Optic ganglion, right.
p. g., Pedal ganglion.
st., Stomach.

Other letterings as in foregoing figures. Dotted line indicates the upper surface of arms.



